A COMPARITIVE EVALUATION OF SURGICAL VERSUS NON SURGICAL MODALITIES IN THE TREATMENT OF CONDYLAR FRACTURES

Dissertation submitted to

THE TAMILNADU Dr.M.G.R.MEDICAL UNIVERSITY

In partial fulfillment for Degree of

MASTER OF DENTAL SURGERY

BRANCH III – ORAL & MAXILLOFACIAL SURGERY

APRIL 2011

RAJAS DENTAL COLLEGE

Raja Nagar, Kavalkinaru – 627105, Tirunelveli District

DCI Recognition No. DE-3 (44)-93/2246, Dated 09/11/1993
Affiliated to the Tamil Nadu Dr. M.G.R. Medical University, Chennai

CERTIFICATE

This is to certify that this dissertation entitled **"A COMPARITIVE EVALUATION OF SURGICAL VERSUS NON SURGICAL MODALITIES IN THE TREATMENT OF CONDYLAR FRACTURES"** is a genuine work done by ***Dr. Renju Prem*** under my guidance during his post graduate study period between 2008-2011.

This Dissertation is submitted to THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSTY, in partial fulfillment for the degree of **MASTER OF DENTAL SURGERY IN ORAL & MAXILLOFACIAL SURGERY - BRANCH III.** It has not been submitted (partial or full) for the award of any other degree or diploma.

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Dedicated To

My Parents, Teachers and God Almighty

Acknowledgement

First of all I reveal my deep sense of gratitude to the Lord Almighty for helping me overcome all odds and for being the unfailing source of support, comfort and strength throughout the completion of the study.

I am sincerely grateful to ***Dr. M.Baskaran,*** *Professor and Head of the Department for his constant encouragement, help, guidance, advice and care throughout the course of this study and in my P.G Curriculum.*

I wish to express my sincere thanks to ***Dr. I. Packiaraj, Assistant Professor,*** *for his constant support and guidance throughout my Curriculum.*

I am extremely grateful to ***Dr.Subramonian, Reader*** *for his valuable guidance, suggestions and encouragement which took me through the completion of this study.*

My Sincere gratitude goes towards ***Dr.Retnakumar****, Reader and* ***Dr.Pradeep****, Senior Lecturer for supporting me all the way through this study.*

I wish to express my special thanks to my colleagues ***Dr.Varun, Dr.Meenakshi, Dr.Binila, Dr.Segin Chandran & Dr.Joy*** *for their support.*

Also I thank our Department Nursing staff ***Mani, Kavitha,*** *and Theatre Assistant* ***Mr. Chellamani*** *for their constant help and support.*

My sincere thanks to all those who have helped me directly and indirectly.

My heartfelt gratitude to ***my parents and friends*** *for their affection and support throughout my course of the study.*

CONTENTS

INTRODUCTION

Fractures of the mandibular condylar process are common injuries that account for 25 – 35% of all mandibular fractures in reported cases[43].

Mandible is one of the prominent bones in the facial skeleton. Since the condyle is the weakest portion of the mandible, it is one of the commonest sites of fractures in the mandible which is a protective mechanism as well. The term condylar fracture is restricted to those fractures which may involve condylar head, anatomical neck or clinical neck of the condyle.

Condylar process fractures occur by the impact of an indirect traumatic force on the chin and seldom arise from direct trauma unless accompanied by fracture of the zygoma. Injury to the condylar region deserves special consideration apart from the rest of the mandible because of anatomical differences and healing potential (ROWE & WILLIAMS).

The commonly accepted, goal of treatment is the reestablishment of the preoperative function of the masticatory system.

This restoration typically involves the reestablishment of the preoperative relationship of the fracture segments, the occlusion and maxillofacial symmetry.

Unlike fractures of the other bones, however the exact anatomic reapproximation of the fracture segments may not be absolutely essential. This fact is certainly demonstrated in children, in whom a conservatively treated displaced or dislocated condylar fracture can heal with a perfectly functional and often morphologically reconstituted condylar process, despite lack of exact reduction at the time of injury.

Depending on the size, speed, and direction of the force of impact, condylar neck fractures may occur unilaterally or bilaterally or in combination with other fractures of the mandible.

Condylar fractures are classified according to anatomical location: intracapsular /extracapsular & according to the degree of dislocation of articular head. Only fracture of the intracapsule or head of the condyle fracture can be treated with closed reduction or conservative method of treatment. Other types of fractures mostly require an open reduction and fixation.

The classic symptoms are disrupted occlusion, pain and hematoma formation in the joint when pressure is applied to the chin, crepitation, and in some cases, bleeding from the ear if the auditory canal is ruptured by the sharp ends of the fracture. There are 2 principal therapeutic approaches to these fractures: functional and surgical.

Functional therapy is adopted most frequently, since it permits early mobilization and adequate functional stimulation of condyle growth (in growing patients). It is indicated in almost all condylar fractures that occur in childhood, that in intracapsular and extracapsular fractures that do not include serious condylar dislocation in adults.

Furthermore DELAIRE recommends functional therapy in cases of both high and low condylar fractures, regardless of displacement. In contrast surgical treatment is indicated primarily for adults with displaced fractures or with dislocation of the condylar head. However there has been no consensus on the therapeutic approach.

WALKER[12] listed the following goals of treatment of condylar process fractures:

1) A reasonably normal, relatively pain free, range of mandibular motion soon after the injury
2) A good occlusion
3) Symmetry of the mandible

He maintained that as long as these goals can be achieved, it seems prudent that the easiest and least invasive treatment should be selected. But the severity of condylar fractures is often underestimated and the clinical outcome can be suboptimal particularly with regard to occlusion following conservative treatment. Also there is reduced incisal opening,

deviation of the mandible, impaired mastication, ankylosis and internal derangement.

Condylar fractures probably represent the aspect of maxillofacial trauma that is most controversial with respect to classification, diagnosis, and therapeutic management and has generated numerous discussions in the literature. Although there are equal studies supporting both open and closed forms of the treatment, there has been considerable increase in the incidence of long term complications associated with the closed forms of the treatment.

EDWARD ELLIS[11] had a greater incidence (27.3%) of malocclusion and THOREN H[55] observed that 39% of patients had deviation of jaw during mouth opening and 22% of patients had joint clicking among those treated with closed reduction.

The clear guideline for treatment and precise functional evaluation of surgical treatment of condylar fractures is still evolving.

This study is aimed at comparing the functional outcome of closed and open modalities of treatment of condylar process fractures.

AIMS AND OBJECTIVES

This is an in-vivo prospective randomised clinical study aimed to evaluate the functional outcome following non surgical and surgical modalities in the treatment of condylar process fractures.

Inclusion criteria for this study were :

1) Unilateral fracture of the condylar process.
2) Age group of 30 to 40 years.
3) Medically fit for surgical intervention.
4) Sufficient bilateral dentition to allow MMF and assessment of occlusal relationships.
5) No history of temporomandibular dysfunction.
6) No gross pretraumatic skeletal malrelationship of the jaws.

REVIEW OF LITERATURE

There is an apparent increase in the number of traumatic fractures of the facial skeleton in recent years due to hazardous mechanical environment. The frequency with which condylar fractures occur among the other fractures of the mandible is attributed to its structural weakness and it is the site for direct or indirect trauma. The search of available literature indicates a variable frequency of its occurrence. The following are the documented statistical data available on condylar fractures among the various fractures of the mandible

PETERS, CALDWELL and OLSEN (1976)[42] described a new safe and efficient technique of open reduction for a displaced subcondylar fracture.

The technique utilized Risdon's incision to expose the fracture site and a stab incision in the preauricular region. A Tennese drill guide or bone screw is introduced through the stab incision to facilitate the placement of drill holes in the fragments, threading with transosseous wires and repositioning of condyle with in the fossa.

ARVITASANEN and LAMBERG (1976)[3] found out that transosseous wiring of mandibular condyle is not an easy method.

But it will reduce the frequency of most of the complications such as open or cross bite and asymmetry of the face. It is not disastrous to the joint and allows good function of the mandibular condyle. The transosseous method was useful in severe cases of condylar fractures at the middle or lower level.

LINDAHL (1977)[37] did radiographic follow up in unilateral condylar fractures in twenty one children and twenty adults for two years. He found that if any injury occurs to the condylar cartilage it loses the capacity of growth and results in asymmetry. In children subcondylar fracture involving symphysis often resulted in deviation towards contralateral side due to overgrowth. On the other hand in adults the condylar head and neck fracture causes deviation of symphysis towards the fractured side and this is due to injury to the cartilage and lack of restitutional remodelling. However , minimal occlusal disturbances were noticed in both children and adults. He concluded that condylar cartilage was responsible for the maintanence of normal condylar head to fossa relation during facial and mandibular growth.

MICHAEL. F . ZIDE and JOHN KENT (1983)[39] in their review of articles had divided the indications for open reduction of condylar fractures into:

Absolute indications for open reduction :

1) Displacement of fractured condylar fragment into the middle cranial fossa
2) Lateral extracapsular deviation of condylar head
3) Inability to achieve occlusion by closed reduction
4) Invasion by foreign body

He further indicates the clinical circumstances for open reduction are:

i) Bilateral or unilateral condylar fracture with crushed midfacial fracture. There the rationale for open reduction is to set the anteroposterior position or midline of the face

ii) Comminuted symphysis fracture and condyle fracture with associated tooth loss

iii) Edentulous or partially edentulous mandible with posterior bite collapse and displaced condyle

AMARATUNGA (1987)[2] in his follow up study of 219 condylar fractures which were treated by closed reduction found that

- Incidence of condylar fractures was 40.2%

- Deviation of jaw on opening was 17.2%
- Reduced interincisal distance was 5.5%
- Patients with bilateral condylar fractures had anterior open bite

TAKENOSHITA et al (1989)[52]in their follow up study of 27 condylar fractures which were treated by open reduction observed that there was:

- Early restoration of function
- No neurosensory deficits

DAHLSTROM et al (1989)[7] in their 15 years follow up study on 36 condylar fractures which were treated by closed reduction found that in children function of masticatory system was good. No major growth disturbances were observed.

In teenagers anatomic and functional restitution of temporomandibular joint was not as good as in children.

JORAM RAVEH (1989)[32] the subject of this study was the evaluation of the results after surgical management of 29 dislocated fractures of the condylar process. Only fractures with total dislocation of the condyle from the articular fossa were surgically treated. The low rate of complications as well as the satisfactory

function of the joint inspite of severe dislocation seems to confirm the surgical treatment of this type of fracture.

TAKENOSHITA et al (1990)[53] compared functional recovery after non –surgical and surgical treatment of condylar fractures in 36 patients and found that satisfactory postoperative function and occlusion at the same level in both groups without any severe complications.

STOELINGER and RUBENS (1990)[44] a study on the management of malunited mandibular condyle fractures. They performed sagittal split osteotomy and the external vertical ramus osteotomy to restore the vertical ramus height. Postoperative observation revealed good functional movements, occlusion and sufficient bite force.

JOACHIM LACHNER et al (1991)[30] in their follow up study of 14 low subcondylar fractures which were treated by intraoral open reduction by percutaneous trocar observed that

- 80% of the fractures demonstrated reduction
- Normal range of motion was achieved in all patients
- Deviation of jaw towards fractured side was seen in 23% of the patients

They also observed the following advantages of intraoral open reduction:

Avoidance of extraoral scars

Avoidance of facial nerve injury

FEIFEL H et al (1992)[19] in their 15 year follow up study of 28 subcondylar fractures in children which were treated by closed reduction found that that there was good aesthetic and functional results although condylar remodeling occurred in half of the individuals, they concluded that there is no indication for open reduction of displaced condyle during growth period.

VITOMIRS. S. KONSTANTINOVIC (1992)[34]compared functional recovery after open and closed reduction of 80 unilateral condylar fractures of which 26 were surgically treated and 54 treated conservatively. There was no statistical difference in functional recovery between both the groups. But radiographic examination showed slightly better position of surgically reduced condylar fractures.

JOHANNES HIDDING et al (1992)[31] in this clinical radiographic study, they reinvestigated 34 patients with dislocated fractures of condylar neck, 20 of the had been treated by open

reduction, 14 in a conservative functional way. The clinical results were nearly equal in both groups, radiographic findings showed considerable deviation in the joint physiology in conservative group. The author recommends open reduction in cases of dislocated sub condylar or condylar neck fractures.

EDWARD ELLIS and THROCKMORTON (1993)[14] reviewed the anatomy and surgical approach for treating fractures of the mandibular condyle with plate and screw fixation. The advantages, disadvantages of the submandibular, preauricular, intra oral, retromandibular and rhytidectomy approaches were discussed.

The retromandibular approach is the most suitable for plate and screw fixation.

HAY WARD et al (1993)[23] in their 50 years review of literature of condylar fractures stated that decision regarding open versus closed reduction in the management of condylar fractures depends upon

- Age of the patient
- Level of the condylar fracture
- Degree of displacement

- Presence of dentition
- Status of existing dentition
- Concomitant injuries
- Presence of foreign body
- Medical status of the patient

SVEN ERIK and VIJAYAKRISHNAN et al (1993)[51] in their 10 years mean observation of 55 patients ranging from 5 - 20 years age group with mandibular condylar fractures treated conservatively. Results were obtained from clinical and radiographic examinations. Clinical dysfunctional values increased significantly with increasing age at the time of trauma. Radiologic abnormalities reduced ramus height, deviation of mandibular midline, and irregular shape of the condyle were seen frequently. No cases of ankylosis. The results support that closed reduction of condylar fractures is sufficient in paediatric patients.

ALEXANDER et al (1994)[1] in their follow up study of 23 low subcondylar fractures which were treated by open reduction with mini plates observed that there were no malocclusions, wound infection and neurosensory deficits. However, malocclusion, impaired masticatory function and pain located to affected joint were

significantly greater (39%) in patients treated by closed reduction compared to those treated surgically (4%). They concluded that dislocated low subcondylar fractures be treated by open reduction.

SILVENNOINEN et al (1994)[48]analyzed the possible factors leading to problems after non surgical treatment of unilateral condylar fractures in 92 patients and it was found that malocclusion occurred due to decreased ramus height and deviation of jaw on mouth opening occurred due to dislocated condylar fractures.

UPRO SILVENNOINEN (1995)[47] in their preliminary follow - up study of seven adult patients with displaced condylar process fractures were treated using axial anchor screw fixation. 2 years post operative follow up , all the patients were free of pain, occlusion and facial symmetry were normal. Radiographs showed excellent fracture reduction. Translation of condyle on mouth opening was symmetrical. Some patients had complications such as unsatisfactory reduction and fracture of the screw. Treatment of condylar process fractures using axial screw fixation is ideal in certain cases.

GIORGIO IANNETTI (1995)[20] this study was done to evaluate the use of external fixation for the treatment of extracapsular fractures of the condyle with luxation of the fragment out of the glenoid fossa. 28 patients had been treated with rigid fixation. They

observed complete recovery of occlusal situation and of the mouth opening. No patient presented with problem.

ILLKA KALLELA et al (1995)[27] in their study of 11 patients underwent surgery for displaced or dislocated mandibular condyle fractures via a submandibular approach and the fragments were fixed using lag screws. After 22 weeks of follow up, clinically all patients had a stable occlusion and symmetry. All had greater than 5mm symmetrical lateral excursions. Despite good clinical results, lag screws do not meet the needs for rigid internal fixation in the treatment of mandibular condyle fractures.

CYRILLE CHOSSEGROS et al (1996)[6] this study was done to evaluate the long -term clinical and radiological results of the short retromandibular approach to displaced subcondylar fractures. In a follow up of 2 years, mouth opening was symmetrical with laterotrusive movements and permanent marginal nerve palsy was never observed.

WIDMARK GOREN et al (1996)[61] in their comparative study of functional recovery after closed and open reduction of unilateral dislocated subcondylar fractures in 32 patients found no significant differences in both the groups in relation to postoperative function and occlusion.

HAMMER et al (1997)[21] in their follow up study of 31 condylar fractures which were treated by open reduction observed that complications such as plate failure and screw loosening was found in 35% of patients treated with single adaptation mini plate whereas complications were minimal with double adaptation mini plates.

HILLERUP. S (1997)[24] in their follow up study of 9 patients with displaced mandibular condylar fractures were treated by open reduction with internal fixation with the aid of ramus osteotomy. 2 years postoperative follow up observation radiographically, sometimes resorption produced flattening of the condyle. 8 patients had deviation to the operated side on maximal mouth opening. The author says by doing this, condyle stays vital because of the blood supply from lateral pterygoidremanants of the joint capsule.

BAKER and MOOS et al (1998)[4] gave a current concensus on the management of mandibular condyle fractures based on questionnaire distributed to member surgeons of AOMSI from the survey they concluded that:

- 57% of the surgeons favoured open reduction of condylar fractures

- 40% preferred closed reduction of condylar fractures with immobilization
- 79% preferred bone plating as an internal fixation device
- 70% preferred preauricular approach for surgical access
- 4% preferred submandibular approach

BANKS PETER (1998)[5] in his review of literature had concluded the following

- Conservative management should be considered in children because of restitutional remodeling
- Open reduction should be reserved for subcondylar fractures associated with loss of vertical ramus height
- Open reduction should be considered when condylar fractures are associated with multiple facial injuries because establishment of stable mandibular platform is essential.

HANNA THOREN (1998)[22] this study evaluates the radiological outcomes of pediatric condylar fractures 37 patients with 45 condylar fractures follow up after 4 years were studied. They observed complete remodeling in 57% of fractures.

- Deformation of condylar neck
- A difference in ramus height between 2 sides
- Dislocated fractures in particular need special attention and long term follow up

NEWMAN L (1998)[40] in his follow up study of 61 patients with condylar fractures 51% of patients had bilateral condylar fractures alone and the remainder also having mandibular fractures. 7% were intracapsular, 48% were of the condylar neck and remaining 45% were sub condylar fractures.

21% of patients were treated with wire intermaxillary fixation for a mean of 37 days. 21% were managed conservatively, and 9 with 10 fractured condyles of patients were managed with open reduction and internal fixation. Postoperatively limited mouth opening was observed in patients treated with IMF, which was significantly less in the ORIF group. He concluded that ORIF is the most satisfactory form of treatment.

EDWARD ELLIS (1998)[11]in his review of literature described the complications of mandibular condylar fractures

1. Malocclusion after closed reduction of condyle could be due to

- Failure in adaptation of neuromuscular system
- Failure to establish lost ramus vertical height
- Failure in restitutional/ functional remodeling in younger individuals.

2. Mandibular hypomobility seen in 8-10% condylar fractures.
3. Deviation of jaw towards side of fracture seen in 50% of condylar fractures.
4. 85% of dislocated fractures cause more dysfunction.
5. Transient weakness of mandibular branch of facial nerve occur in 15 % of patients.

TATEYUKI LIZUKA et al (1998)[54] this study evaluates the long term results of open reduction with fixation for displaced fractures of the condylar process. 27 patients were observed clinically and radiographically. On final follow up of 48% of the cases had a normal condylar configuration radiologically, and remaining cases normal function was established even though there were condylar

changes. They say the surgical management described enables a satisfactory outcome to be achieved with dislocated condylar process fractures.

EDWARD ELLIS et al (1999)[17] compared mandibular motion after closed and treatment of unilateral sub condylar fractures in 136 patients on fractured side than those patients treated by closed reduction they concluded that open reduction produces functional benefits to patients with severely displaced condylar process fractures.

EDWARD ELLIS et al (1999)[16] studied the changes in position of fractured condylar process immediately before and after closed reduction of 66 unilateral condylar fractures they found that fractured segment was displaced medially or laterally after closed reduction in significant number of 26 patients (40%) and also noted that fractured segment was displaced either anteriorly or posteriorly in less number of 9 patients (14%). They concluded that open reduction must be considered in displaced and dislocated condylar process fractures.

SANTLER .P. KARCHER et al (1999)[45] this study was to compare the outcomes from the surgical and non surgical treatment of condylar process fractures. 234 patients with fractures of

mandibular condylar process were treated by open or closed methods. 150 patients with a mean follow up time of 2 years were analyzed using radiologic and objective and subjective clinical examinations

No significant differences in mobility, joint problems, occlusion, muscle pain, or nerve disorders were observed when the surgically and non surgically treated patients were compared.

STROBL et al (1999)[50] treated 55 children with unilateral fracture non- surgically using an intra oral myofunctional appliance. They found that no patients showed occlusal or functional disturbances or any TMJ pain or dysfunction. Remodeling was complete in all the cases. Patient age group 7-10 years showed in complete regeneration resulting in condylar deformity in 2 cases, reduced neck height in 2 cases and hypertrophic condylar deformity in 4 cases, however there was no incidence of ankylosis.

EDWARD ELLIS (2000)[12] compared occlusal results after open and closed treatment of unilateral fractures of mandibular condylar process in 137 patients treated by closed reduction had a greater percentage of malocclusion (27.3%) than patients treated by open reduction. They stressed that consistent occlusal results can be achieved when condylar fractures are treated by open reduction.

EDWARD ELLIS et al (2000)[15] in their follow up study of 61 unilateral condylar process fractures which were treated by open reduction observed that :

- Immediately after open reduction, the difference in position between fractured and non fractured sides averaged less than 2 degrees indicating good anatomic reduction of fractures.
- They also observed that 10-20% of condylar process had post surgical changes in position of more than 10 degrees.

TULIO et al (2000)[57]in their 2 year follow up study of 9 dislocated condylar fractures which were treated by open reduction observed that;

- Good amount of mouth opening in all patients
- Minimal deviation or pain in all patients
- Radiographic observation revealed restoration of posterior facial height in all the patients

THOREN H. et al (2001)[55]in their 10 year follow up study of 26 dislocated condylar fractures which were treated by closed reduction observed that :

- 39% of the patients had deviation of jaw during opening

- 22% of the patients had joint clicking
- 10% had reduced range of mouth opening
- 5% had pain in TMJ region

Their radiologic observation revealed :

- Incomplete remodelling in 76.5% of patients
- Asymmetry of mandible in 65% of patients

MATTHIAS et al (2002)[38]studied different lines of intracapsular fractures of mandibular condyle in 40 patients and evaluated their influence on prognosis after closed treatment. They found moderate to serious dysfunction occurred in (33%) of the cases and also reported that comminuted fractures has got worst prognosis followed by fractures associated with loss of vertical height of mandibular ramus.

HYDE et al (2002)[26] in their prospective study of 28 unilateral mandibular condyle fractures which were treated by open reduction observed that normal mouth opening, full range of mandibular excursions were achieved in all the patients. They stressed the displaced condylar fractures should be treated by open reduction.

LEON A. ASSAEL (2003)[36]evaluated various factors affecting the management of mandibular condyle fractures by open and closed methods. He concluded that malocclusion, masticatory functional deficits and internal derangements occur in both surgical and non surgical patients. He also added that patients age, gender, systemic diseases, patient complaints, risk of infection, nerve injury, scaring, chronic pain, osteoarthrosis and bone resorption, and associated mandible and midface fractures, and patients expectations are the factors that influence the treatment of mandibular condylar fractures either by surgical or non surgical methods.

TODD BRANDT and HAUG (2003)[56] did a review of literature regarding the evaluation of current thoughts on management of mandibular condyle fractures in adults (open versus closed) . They discussed about Lindahl classification of condylar fractures, indications for open reduction by Zide and Kent (1983), (1989), (1990). And compared the outcomes of open reduction internal fixation versus closed reduction and maxillomandibular fixation given by various authors. They suggested open reduction provides better functional reconstruction of mandibular condyle by endoscopic surgical technique.

SMETS and STOELINGA et al (2003)[49] in their follow up study of 60 patients with 71 condylar fractures were treated by non surgical fashion. The retrospective study, including clinical analysis of occlusion, asymmetry at rest during mouth opening, maximum interincisal distance, signs of TMJ dysfunction and analysis of radiographic data i.e. shortening of ascending ramus as measured on sequential O.P.G

- They found 8% with an unacceptable malocclusion and one with limited mouth opening
- 92% had none or only minor signs of TMJ dysfunction not requiring further treatment
- The author says only in selected patients with shortening of the ascending ramus of 8mm or more and / or considerable displacement of the condylar fragment, surgically repositioning and rigid internal fixation should be considered.

VILLAREAL et al (2004)[58]this study was done to analyze the principal variables that determine the choice of the method of treatment and the outcome in condylar fractures. They conducted a retrospective analysis of 104 mandibular condyle fractures. All the

patients underwent a clinicoradiologic investigation focusing on fracture remodeling, evaluation, dental occlusion, symmetry of the mandible. The principal factors that determined the treatment decision were the level of fracture and the degree of displacement. The level of the fracture influenced the degree of pre operative coronal and sagittal displacement and treatment applied. The functional improvement obtained by open method was greater than that obtained by closed treatment.

C.A LANDES and R.LIPPHARDT (2005)[35] evaluated outcomes of closed reduction in non-displaced, non-dislocated condyle and subcondylar fractures (class I) and open reduction and internal fixation of displaced (class II) and dislocated (class IV) fractures. The results of this study indicated successful management of classes I, II and IV fractures with a practical approach of gradual differentiation and ORIF was indicated for dislocated fractures which showed the results to be successful.

KAZHUHIRO et al (2006)[33] evaluated the biomechanical stability of various internal fixation systems for subcondylar fractures. In perpendicular fracture, double adaptation plate showed the highest level of tolerance load followed by Eckelt lag screws and PLLA plate. Double adaptation plate fixation proved to have superior

biomechanical stability in both fracture conditions (perpendicular and oblique subcondylar fracture).

FEDERICO BIGLIOLI (2009)[18] suggested that the mini retromandibular approach is ideal for condylar fracture management, because it allows for easy , fast reduction and osteosynthesis while minimizing the risk of facial nerve injury and visible scars.

WEI TANG et al (2009)[60] concluded that open reduction and internal fixation of condylar fractures by using the modified retromandibular approach indirectly from the anterior edge of the parotid gland has many advantages. Compared with the traditional surgical incision, this method is simple and short , and the completely exposed operative field facilitates reduction and fixation. It also substantially reduces the risk to the facial nerve as in transparotid approaches. At the same time, this method is not only suitable for the surgical treatment of condylar fractures but also for those of the mandibular ramus and coronoid process.

VINOD NARAYANAN et al (2009)[59] evaluated the efficiency and safety of a retromandibular approach to reduce and fix displaced condylar fractures. The advantages suggested included shorter working distance from the skin incision to the condyle, greater access to the posterior border of the mandible and sigmoid notch,

little risk of facial nerve damage, less conspicuous facial scar and easy reduction.

JANN KLATT et al (2010)[28] suggested that the transparotid approach to condylar process fractures is most appropriate for strongly displaced class II fractures. Especially for very old patients with dementia, for whom maxillomandibular fixation is contraindicated, this approach is very appropriate. Another benefit to this type of approach is the short operating time, with an average of 45 minutes.

METHODOLOGY

This clinical study was conducted on 16 patients from the department of Oral and Maxillofacial Surgery, Rajas Dental College from Aug 2008 to Aug 2010.

The patients were grouped into two main categories as per the main objective of the study; to compare the functional outcome between surgical and nonsurgical modalities in the treatment of condylar fractures.

GROUP I - comprised of 8 patients treated by closed reduction

GROUP II - comprised of 8 patients treated by open reduction

A specific patient selection criteria and protocol were followed

A proforma was created to record the history and events

Preoperative radiographs, patient photographs and clinical records were made mandatory

Choice of anaesthesia - 8 patients underwent surgical procedures under general anaesthesia and 8 patients were subjected to Erich Arch Bar wiring and intermaxillary fixation under local anaesthesia, followed by the placement of elastics.

The period of follow up for both categories were ranging from 0- 18 months.

The clinical parameters for evaluation in the study were :

- Maximum interincisal opening
- Right lateral excursion
- Left lateral excursion
- Occlusion
- Contour Perception
- Pain
- Protrusive movement

Following completion of the treatment in both the study groups, the patients were assessed under the following criteria at intervals of 3 weeks, 6 weeks, 3 months, 6 months, and further.

Patients in group I who sustained fracture of the mandible other than the condylar process fracture were rigidly stabilized using ORIF.

TABLE 1 - SAMPLE CHARACTERISTICS

Characteristics of Mandibular Condylar Fractures

1.	**Location of Condylar Fracture**	**Closed**	**Open**
	Condylar head fracture	8	-
	Condylar neck fracture	-	4
	Subcondylar fracture	-	4
	Total	**8**	**8**

		Closed	**Open**
2.	Unilateral Condylar Fracture	8	8
	Bilateral condylar fractures	-	-

3.	Period of Fracture	**Closed**	**Open**
	< 10 days	8	7
	>10 days	-	1

4.	Associated Mandibular Fracture	**Closed**	**Open**
	Symphysis	2	2
	Parasymphysis	-	-

5.	Associated Facial Fractures	**Closed**	**Open**
	Zygomaticomaxillary complex	-	-

TABLE 2

Distribution of the types of fractures in accordance with **SPIESSEL and SCHROLL**

		No. Of open treated fractures (n=8)	No. Of closed treated fractures (n=8)
Type I	Condylar fracture without angulation and dislocation	-	4
Type II	Low condylar fracture with angulation	1	-
Type III	High condylar fracture with angulation	2	2
Type IV	Low condylar fracture with dislocation	3	-
Type V	High condylar fracture with dislocation	2	2

The patients in this study were assessed based on the scale of scores for pain, perceptibility of scar, restoration to pretraumatic occlusion, and symmetry of contour.

Perceptibility of Scar

1 - Not present

2 - Perceivable

3 - Acceptable

4 - Detracting

5 - Deforming

Restoration to the pretraumatic occlusion

1 - Identical to pretraumatic

2 - Slight difference

3 - Functional malocclusion

4 - Requires orthodontics as occlusal adjustments

5 - Gross malocclusion

Symmetry of contour

1 - No perceivable deformity

2 - Can perceive with a detailed examination on palpation

3 - Mild deficit

4 - Moderate deformity

5 - Limits daily function

Pain

1 - None

2 - Occasional

3 - Tolerable

4 - Occasional limitation of daily activity

5 - Limits daily function

Patients were then examined for:

1. Maximum interincisal opening - (mm)
2. Right lateral excursion - (mm)
3. Left lateral excursion - (mm)
4. Protrusive movement - (mm)

CASE HISTORY PROFORMA

Date:

Name :

Age :

Sex :

Address :

Occupation :

Chief Complaint :

History of Presenting Illness :

Past Medical History :

Drug Allergy :

Past Dental History :

Family History :

Personal History :

General Examination:

- BP
- Pulse
- Respiratory rate
- Temperature
- Weight
- Icterus
- Pallor
- Clubbing
- Cyanosis
- Lymphadenopathy
- Oedema

Systemic Examination:

- CVS
- RS
- Abdomen

Extra Oral Examination:

- Inspection
- Palpation
- Auscultation

Intra-Oral Examination:

- Inspection
- Palpation
- Percussion

Tongue
Floor of mouth
Buccal Mucosa
Labial Mucosa
Vestibule

Provisional Diagnosis :

Investigations :

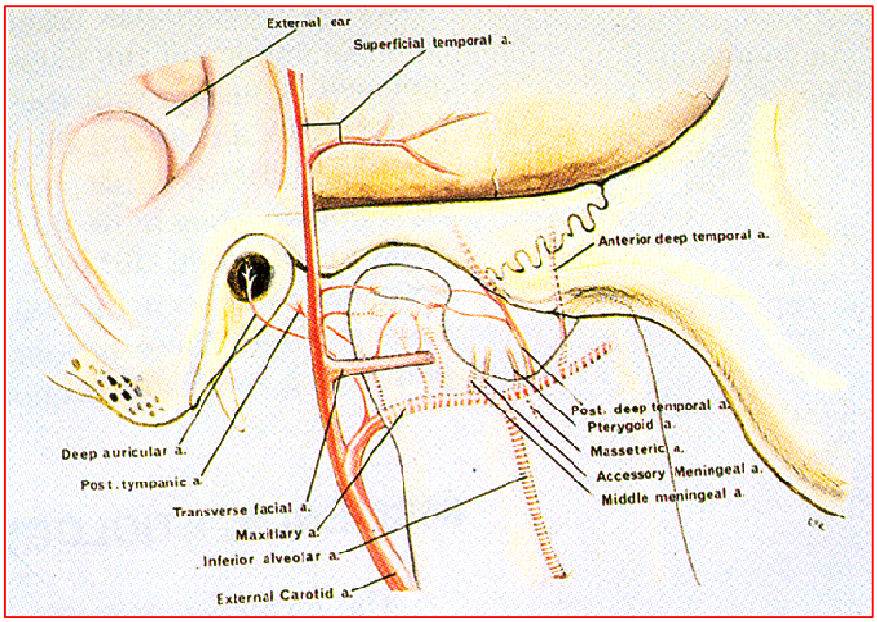
Final Diagnosis :

Treatment Plan :

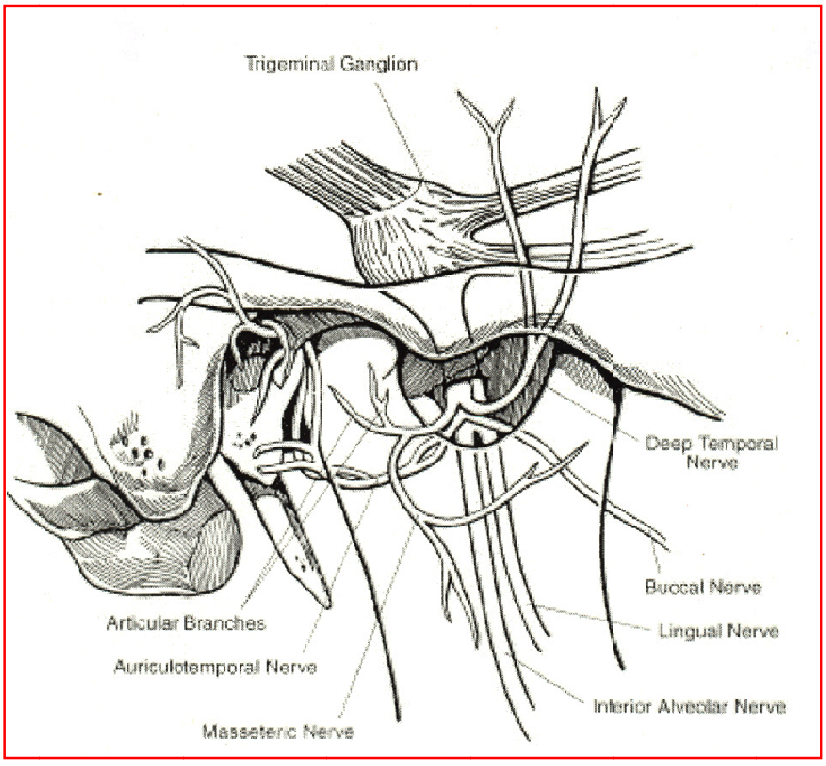
Follow Up :

SURGICAL ANATOMY

Blood supply of the TMJ



Nerve supply of TMJ



SURGICAL APPROACHES

The surgical approach preferred in the cases treated by open reduction in this clinical study sample were :

1) Preauricular approach
2) Retromandibular approach

Preauricular approach

Fig: Initial Incision made in the preauricular skin fold

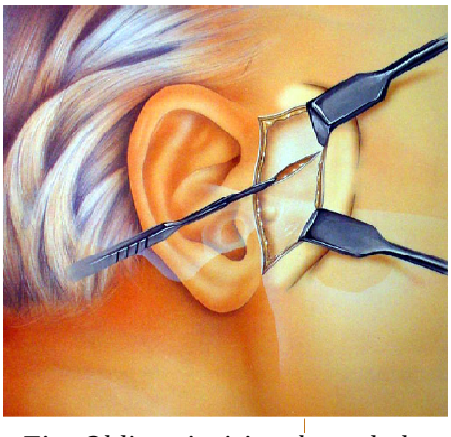


Fig: Oblique incision through the superficial layer of temporalis facia. Fat is visible deep to the facia

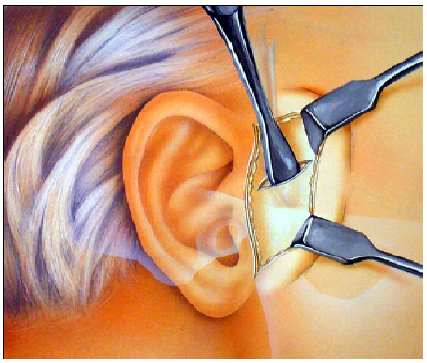


Fig: A periosteal elevator inserted beneath the superficial layer of the temporalis muscle is used to strip periosteum off the lateral portion of the zygomatic arch, and continues the dissection below the arch just superficial to the capsule of the temporomandibular joint.

Retromandibular Approach

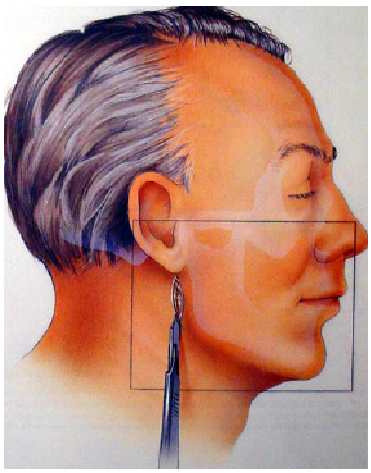


Fig: Vertical incision just posterior to the mandible through skin and subcutaneous tissue to the depth of the platysma muscle.

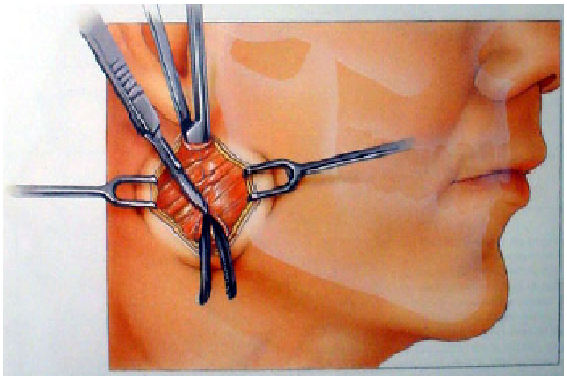


Fig: Sharp dissection through the thin platysma muscle, SMAS and parotid capsule after undermining with a haemostat.

Fig: Blunt haemostat dissection through the parotid gland, spreading in the direction of the fibers of VII Nerve.

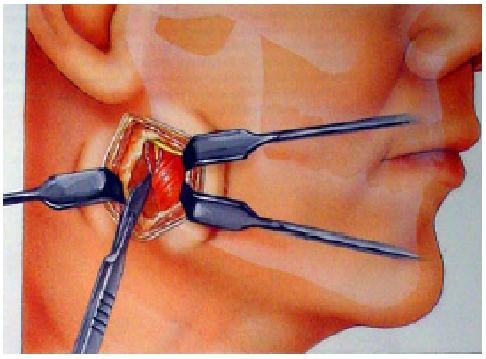
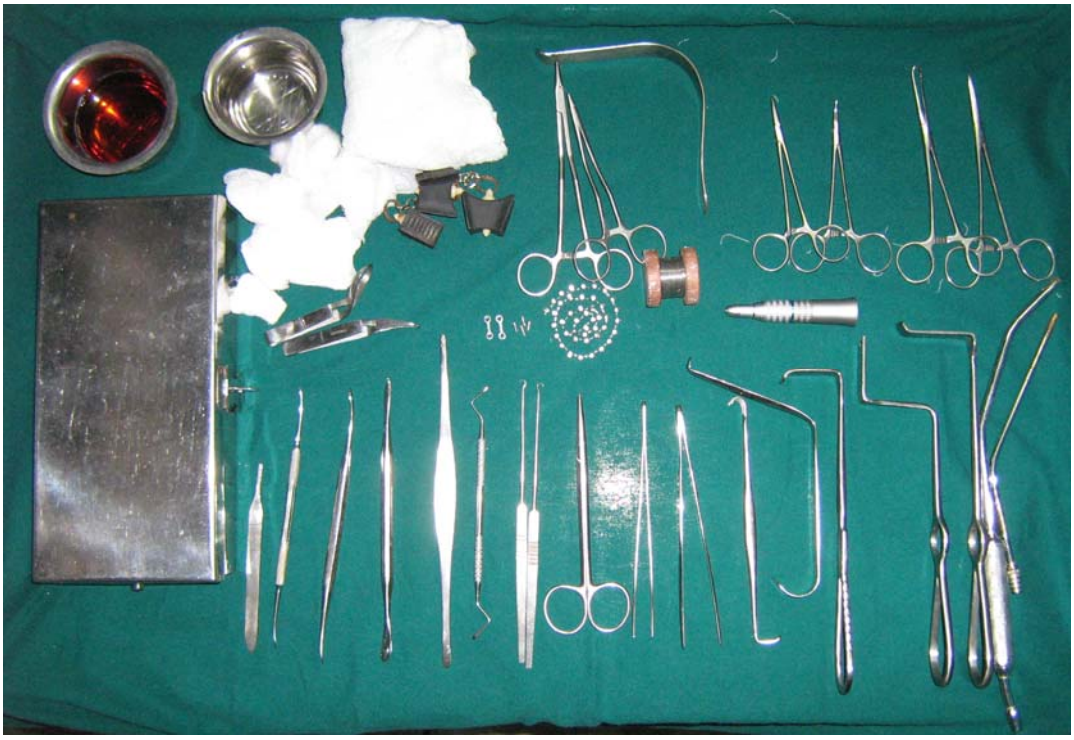


Fig: Incision through the pterygomasseteric sling along the posterior border of the mandible. The inferior division of VII nerve is being retracted superiorly.

ARMAMENTARIUM



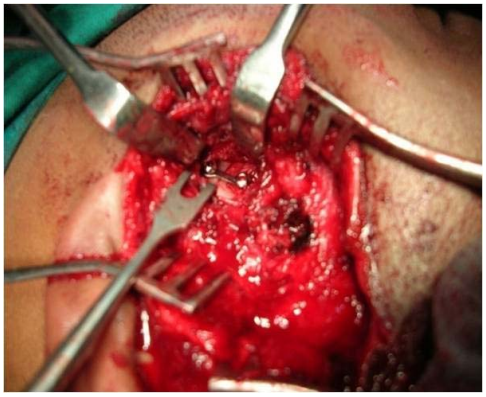
CASE – 1

Open Reduction – Preauricular Approach

Preoperative X-ray showing Left condylar neck fracture

Incision made in the preauricular skin fold

Exposure of the fracture site



Fracture reduced and fixed with mini – plate

Skin closure

POST OPERATIVE FOLLOW-UP

Postoperative x-ray showing mini plate fixation

Postoperative occlusion

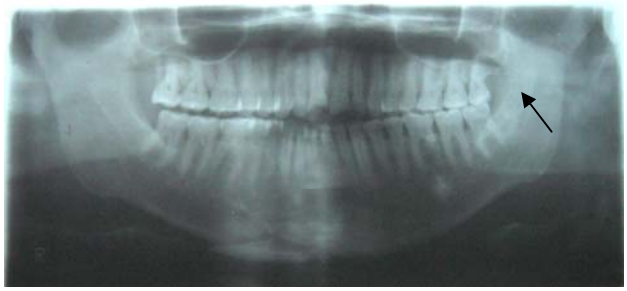
Postoperative evaluation of facial nerve function

Perceptibility of Scar – Acceptable

Post operative mouth opening

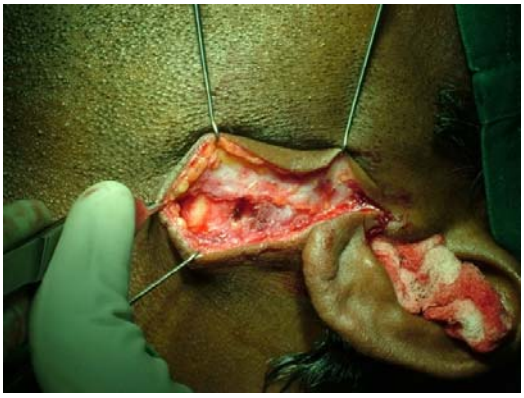
CASE – 2

Open Reduction – Retromandibular Approach

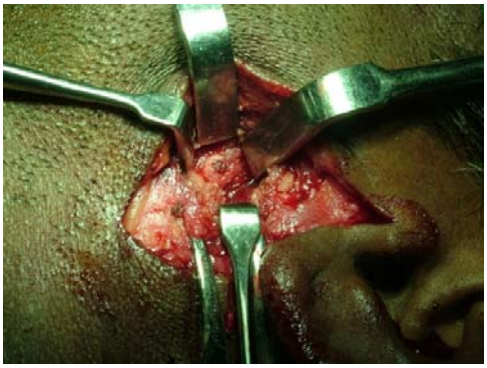


OPG showing left sub Condylar fracture

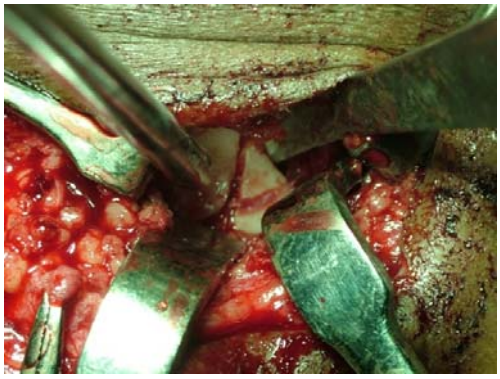
Incision just posterior to the mandible through skin and subcutaneous tissue to the depth of the platysma muscle



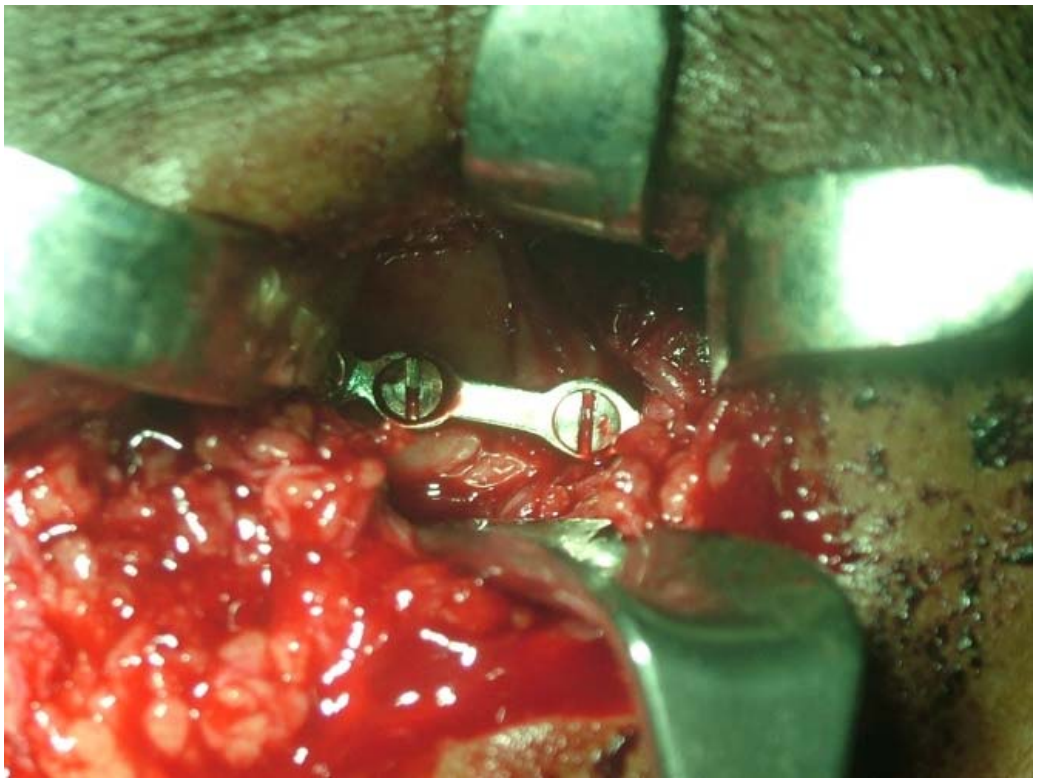
Sharp dissection through the thin platysma muscle, SMAS and parotid capsule.



Division through pterygomasseteric sling along the superior border of the mandible



Exposure of the fracture site



Facture reduced and fixed with 1 four hole mini plate

Post operative patient subjected to arch bar fixation with elastics

Post operative occlusion

Postoperative evaluation of facial nerve function

CASE – 3

Closed Reduction

OPG showing left Condylar Head fracture and Mandibular Symphyseal fracture treated with 2 four hole mini plates

Condylar fracture treated with Erich Arch Bar and intermaxillaryfixation

Postoperative occlusion evaluated at 1 month and 3 month periods

RESULTS

16 patients with unilateral condylar fractures were included in this study. 8 patients were treated conservatively and 8 patients underwent open reduction and rigid internal fixation. The patients were regularly followed for different clinical parameters and the follow up period ranged from 0- 18 months :

The different values obtained with the clinical parameters were

CLOSED REDUCTION - GROUP I

OPEN REDUCTION - GROUP II

TABLE 1

CLOSED REDUCTION-SAMPLE

	Case 1	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**	**Case 7**	**Case 8**
Time since operations (mos)	18	16	16	14	10	8	8	6
Maximum inter incisal opening (mm)	38	37	35	38	32	30	32	30
Right lateral excursion (mm)	7	6	8	7	4	3	4	3
Left lateral excursion (mm)	3	4	4	3	7	6	7	7
Occlusion	2	1	1	3	1	2	2	2
Contour perception	1	1	1	1	1	1	2	1
Pain	1	2	1	2	3	2	3	2
Protrusive movement (mm)	7	5	6	4	5	6	4	5

TABLE 2

OPEN REDUCTION-SAMPLE

	Case 1	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**	**Case 7**	**Case 8**
Time since operations (mos)	12	12	10	9	8	8	6	6
Maximum inter incisal opening (mm)	45	42	43	39	38	39	40	38
Right lateral excursion (mm)	8	7	8	7	5	4	5	4
Left lateral excursion (mm)	4	5	5	4	8	7	6	7
Occlusion	1	1	1	1	1	1	1	2
Contour perception	1	1	1	1	2	1	1	1
Pain	1	1	1	1	2	1	1	2
Protrusive movement (mm)	8	9	8	7	8	7	7	6

TABLE 3

STATISTICAL SIGNIFICANCE

(Evaluated with Independent 't' test and p values at < 0.05 and < 0.01)

	Sum	Mean	Standard Deviation	t-Value	p-Value
Time since operations (mos)	96	12	4.535574	1.73	Nothing Significant
Maximum inter incisal opening (mm)	272	34	3.422614	-4.31 (<0.01)	0
Right lateral excursion (mm)	42	5.25	1.982062	-0.82	Nothing Significant
Left lateral excursion (mm)	41	5.125	1.807722	-0.76	Nothing Significant
Occlusion	14	1.75	0.707107	2.24 (<0.05)	0.04
Contour perception	9	1.125	0.353553	0	Nothing Significant
Pain	16	2	0.755929	2.39 (<0.05)	0.03
Protrusive movement (mm)	42	5.25	1.035098	-4.58 (<0.01)	0

TABLE 4

FACIAL NERVE WEAKNESS REPORTED AFTER SURGICAL TREATMENT OF CONDYLAR FRACTURES

Approach	Interventions	Temporary Weakness	Permanent Palsy
Pre-auricular	4	1 (25%)	-
Retromandibular	4	1 (25%)	-
Total	8	2 (25%)	0 (0%)

FIGURE 1

CLOSED REDUCTION-SAMPLE

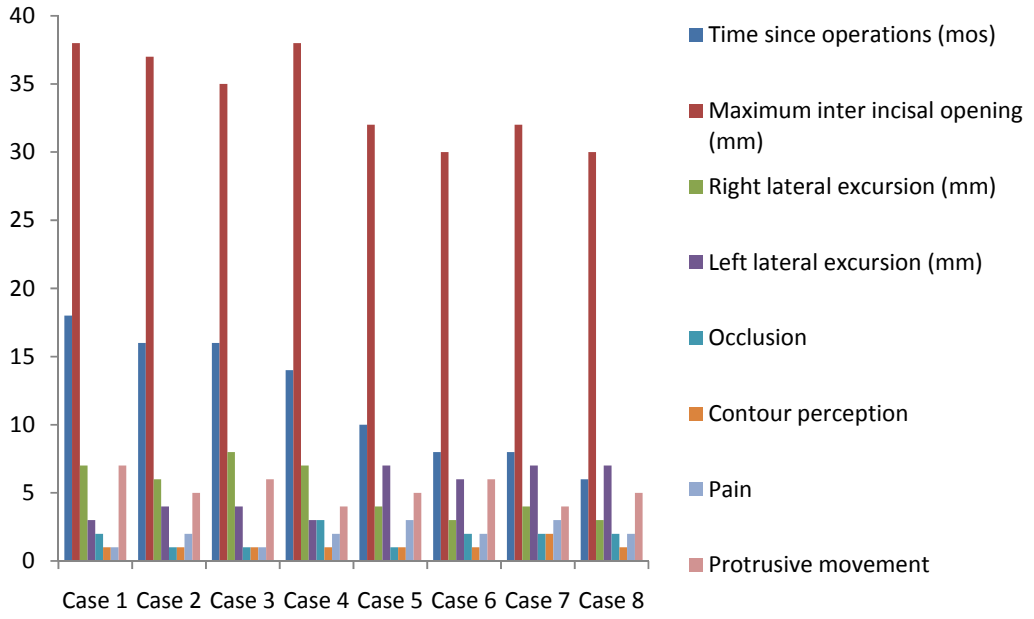


FIGURE 2

OPEN REDUCTION-SAMPLE

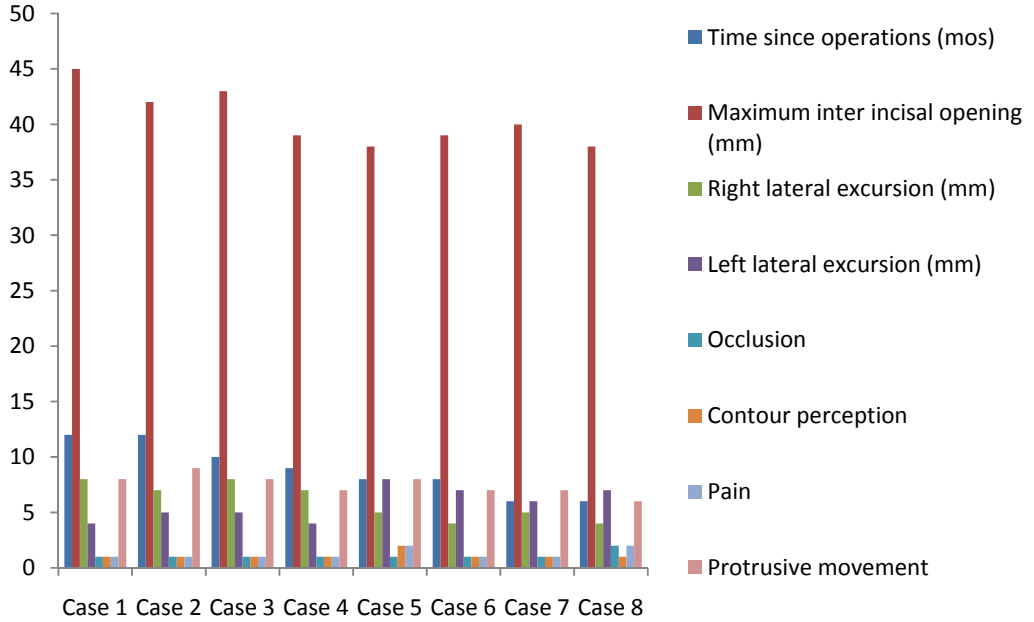
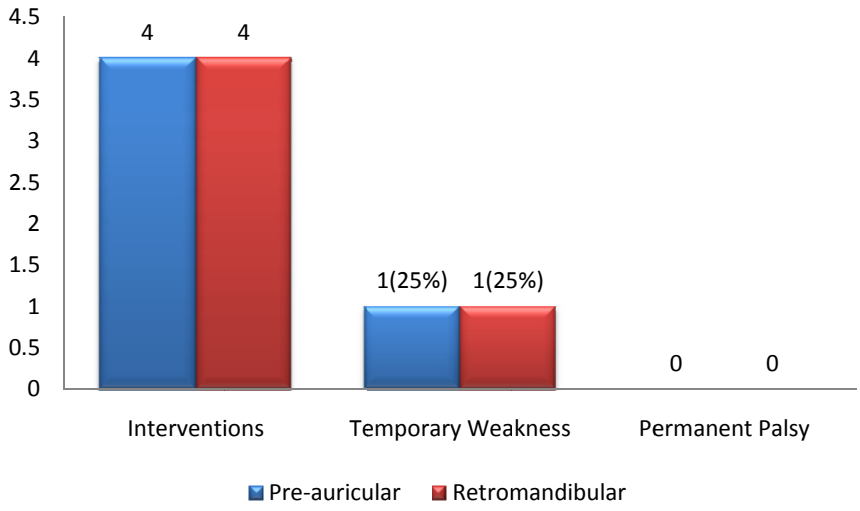


FIGURE 3

BAR DIAGRAM SHOWING FACIAL NERVE WEAKNESS AFTER SURGICAL TREATMENT OF CONDYLAR FRACTURES



REMARKS

- No statistical significant differences were noted between the two groups for the time since operation, right and left lateral excursive movements, and contour perception.
- Significant statistical differences were noted among the two groups in the category of maximum interincisal opening, occlusion, pain and protrusive movement.
- Statistically significant differences were noted in the perception of pain (< 0.05) with the patients in group I treated by closed reduction.
- 2 cases in group II treated by open reduction had an incidence of transient facial nerve weakness which returned to normal function over a period of follow-up.

DISCUSSION

Due to hazardous mechanised environment there is an apparent increase in the incidence of traumatic injuries to the mandibular condyle in recent years. Since the incidence of this fracture is highest, compared to other facial bilateral fractures, its management also appears to be very important because it has a significant bearing on the functioning of the temporomandibular joint.

Most of the literature on condylar fractures is incomplete and sporadic, which describes the treatment of a small number of cases but fail to give a comprehensive picture of fracture management. Till now the treatment of fracture of mandibular condyle is considered to be one of the most controversial and debatable topics in the field of Oral and maxillofacial surgery.

From the literature it is clear that the treatment modalities used in the management of condylar fracture fall into two main groups: one being the conservative and the other being open reduction and fixation.

This controversy in the treatment is attributable to the peculiar anatomy of the area and to the close proximity of its parts which are concerned in the function of the mandible mainly to the TMJ.

Even though the TM joints appear to be two joints morphologically, functionally they act like a single unit. So injury to one side will interfere with the function of the other joint.

In cases of children before completion of skeletal growth, the condylar joint plays a major role in the downward and forward growth of the mandible which adds to the importance of the condyle in growth of the lower third facial skeleton. So the narrow outlook towards a very broad problem of management of condylar fracture forms two extremes:

i) Conservative management

ii) Surgical treatment

There is a general opinion that any fractured or displaced bone should be brought back to its original anatomical alignment, which aids in normal healing and to regain normal function. Though there are a variety of opinion regarding treatment of condylar fractures, the ultimate aim in any treatment is to obtain desirable results of satisfactory function of mandible which includes growth in children, restoration of normal function with correct occlusion and the elimination of associated deformity.

Each theory of management contribute something to solve the problem of all condylar fractures. Early reduction and immobilisation is the key note in satisfactory management and thus the clinical classification of condylar fracture was put forward by Dr. W.D. MACLENNAN (1952) which gives an idea regarding the selection of modalities of treatment.

MAC LENNAN (1952) classified the condylar fractures according to the position of the condylar head to the glenoid fossa and the relation of fractured segments and is most widely accepted. He described them as follows:

a) Fracture of the condyle with no displacement
b) Fracture of the condyle with displacement
c) Fracture of the condyle with deviation
d) Fracture of the condyle with dislocation

Since condylar fractures are commonly associated with other mandibular fractures combined evaluation and management are necessary.

Fractures of the mandibular condyle are common and account for 25-35% of all mandibular fractures[43].

In 1955 ROWE & KILLEY devised a classification system based on the relationship to the temporomandibular joint capsule and concomitant injury. They are - intracapsular , extracpsular, fractures associated with injury to the capsule, ligaments and meniscus and fractures involving the adjacent bone.

Intracapsular fractures included those that involved the articular surface, or those that occurred above or through the condylar neck.

Extracapsular fractures were those that “run from the lowest point of the sigmoid notch backwards below the surgical neck of the condyle to the posterior aspect of the upper part of ramus”.

Complications of trauma to the temperomandibular joint (TMJ) are far-reaching in their effects and not always immediately present. Disturbance of occlusal function, deviation of mandible, internal derangements, and ankylosis of the joint with resultant inability to move the jaw are all sequelae of this injury.

Condylar fractures were treated by closed reduction in many centers in the past. This preference is largely the result of 3 main factors:

First, nonsurgical treatment could give “satisfactory” results in many cases.

Second, there are no large series of patients reported in the literature who had been followed after surgical treatment because management of condylar fractures has historically been with nonsurgical means.

Third, surgery of condylar fractures is difficult because of the inherent anatomical hazards (e.g facial nerve palsy).

The major problems resulting from treatment of displaced articular fractures by closed reduction are not only early dysfunctioning but late arthritic changes 10 to 30 years later in a joint that is not in its appropriate anatomic position[12].

Long term sequelae associated with closed reduction modality of treatment are pain, arthritis and limitation of motion.

Fractures of the condylar process treated by nonsurgical means undergoes a complex series of adaptations that attempt to restore an articulation to facilitate masticatory function. These adaptations begin immediately after injury, but differ somewhat in their timing and importance.

There are 3 main types of adaptations that occur:

i) Neuromuscular

ii) Skeletal

iii) Dental

Another functional component of the masticatory system that could be hindered by a condylar process fracture is mandibular mobility and asymmetrical motion.

With fracture, the normal translation and rotation of the mandibular component of the TMJ can be upset. Further, the action of the lateral pterygoid muscle may no longer exert its action on the distal portion of the mandible , resulting in deviation toward the site of fracture when the mouth is opened.

Several studies have shown dramatic differences in the amount of lateral deviation on opening and protrusive excursion after patients were treated by closed means[2].

SILVENNOINEN[48] et al found 30% of their condylar fractures treated closed had persistent deviation on opening.

A study by PALMIERI[41] et al found that patients treated by closed means, on the average, deviated toward the side of the fracture, but the average amount of deviation was less than 2mm at most time periods.

The combination of a damaged condylar process and immobilisation may cause a cicatricial reduction in condylar translation, resulting in deviation toward the side of fracture on opening or in protrusion.

The optimum condition for articular repair is by active or passive motion of the joint. Conversely, immobilisation of a deranged joint leads to degeneration of the articular surfaces and development of fibrous adhesions, limiting mobility[13].

It has been shown that closed treatment of condylar fractures results in centric relation-centric occlusion discrepancies[7,37].

With closed treatment of condylar process fractures, extrusion of the incisors and intrusion of the molars has been demonstrated . This is because as the ramus moves superiorly to assist in the reestablishment of a new temperomandibular articulation, the only way this can happen without a malocclusion developing is for the molars to intrude and the incisors to extrude. This is especially common in patients treated by closed form with bilateral fractures of the mandibular condylar process. In these patients there is a strong tendency for an anterior open bite occlusal relationship to develop.

It has also been shown that the mandibular plane angle increases with closed treatment in these group of patients[14].

When elastics are applied to the anterior teeth during treatment, the incisors extrude and the molars intrude. Therefore, given the skeletal

adaptations that are occurring, dental adaptations are necessary for maintenance of the normal occlusal relationship.

Conceivably ,open reduction and internal fixation of the fractured condylar process would obviate the necessity for these neuromuscular, skeletal and dental adaptations[13].

It has been shown that there is less loss of posterior vertical dimension and dental adaptations with open treatment. There is less remodelling of the condylar process after open treatment, presumably because the articulation is re-established surgically[14].

Varying periods of maxillomandibular fixation (MMF) for condylar fractures has been suggested in the literature. However, the duration of MMF that is recommended ranges from no MMF to " until the fracture heals" or up to 6 weeks by others.

CONVERSE suggested that the occlusion must be maintained by MMF until fibrous union of the fractured fragments is established.

Early mobilization of the jaw and functional rehabilitation is considered important by many surgeons.

The following factors influence the selection of method for open reduction:

1) Position of condyle
2) Location of fracture
3) Age of fracture
4) Character of patient
5) Amount of oedema
6) Location of incision
7) Type of fixation

Enthusiasm for open reduction of condylar process fractures has increased over the past 20 years with the wide availability of plate and screw fixation systems.

ZIDE & KENT'S[39] classic report regarding the indications for open reduction of mandibular condylar process fractures has been the "gold standard" for the past decade and a half.

To determine whether or not open reduction of condylar process fractures is biologically sound certain factors such as surgical anatomy of the TMJ area, blood supply to the condyle are taken into consideration.

The TMJ as whole is supplied by a very rich plexus of vessels that runs throughout the tissues of the area.

Concerning the condyle itself , its blood supply is mostly derived from 3 sources:

A branch of the inferior alveolar artery courses upward through the neck of the condylar process, where it anastomoses liberally with the vessels from the attached musculature.

Another major component to the condyle and its articular surface is derived from the TMJ capsule, with its lush vascular plexus.

There is also a large contribution of blood supply from branches of the lateral pterygoid muscle through its attachment at the pterygoid fovea.

Fracture of the subcondylar or neck region of the condylar process could therefore disrupt the main vascular supply to the condyle. There are several ramifications to this alteration in blood supply.

First is the maintanence and /or re-establishment of sufficient blood supply to confer viability to the condyle and surrounding tissues. With the disruption of medullary source of blood supply, the other sources of vasculature become more active.

There is another ramification of the loss of medullary blood supply from fracture of the condylar process.

Surgical manipulation further diminishes the blood supply to a segment of bone that is already compromised.

If maintenance of blood supply to the condyle is important, a surgical approach that minimizes the amount of soft tissue stripping from the fractured condylar process, the attachment of the TMJ capsule and the lateral pterygoid muscle is taken into consideration.

Thus if the preauricular approach is chosen, care should be taken not enter the capsule of the joint. Doing so can disrupt the already compromised blood supply to the condyle. The dissection is kept superficial to the capsule to a point inferior to where it attaches to the condylar process.

Similarly in a retromandibular or a submandibular approach, the soft tissue stripping is done from the inferior portion of the condylar process up to the point where the capsule attaches.

The main reasons for open reduction and internal fixation of condylar fractures are to permit primary healing and to avoid IMF[58].

The decision to proceed with ORIF generates two other inter-related controversial issues namely, the type of fixation device that should be employed ,and the choice of surgical approach. The anatomical level of condylar fracture, fixation method used, presence of other

fractures, surgical expertise available and concerns regarding cosmesis all influence the selection of surgical approach.

The keys for successful open reduction and rigid fixation are

i) Good exposure

ii) Anatomic reduction without destroying the cartilage surface of the condyle and lateral pterygoid muscle

iii) Stable fixation

iv) And disc reposition

Surgical access to the TMJ is an exacting procedure which requires a good technical skill and a thorough knowledge of the anatomy of the area. Proximity to the main trunk of the facial nerve with its branches on to the facial and temporal areas, and to the auriculotemporal nerve this surgery one of the most versatile and at the same time equally challenging.

Additional advantages of ORIF are a more rapid return to pretraumatic function, enhanced nutrition and a protected airway[36]. The decision to use ORIF on one anatomic region that affects the occlusion may warrant its application to all functional components of the masticatory system.

ORIF is contraindicated for the management of condylar head fractures (whether single fragment, comminuted, or medial pole, at or above the ligamentous attachment). There is a high risk of avascular necrosis with the associated loss of a functioning condyle and the potential of a fibrous or osseous ankylosis and the need for removal of loose hardware.

Pre and post - auricular approaches are suitable for intracapsular and high condylar neck fractures where ORIF is indicated.

Submandibular, retromandibular and the rhytidectomy modification approaches are preferred for low condylar fractures. The intraoral approach and its endoscopically assisted modifications may offer better cosmetic results.

Retromandibular approach was first described in 1967 by HINDS and GIROTTI in relation to vertical subcondylar osteotomies and was later popularized for the management of condylar fractures. It was modified by KOBERG and MOMMA (1978)[59].

This approach allows exposure of the entire ramus of the mandible including the condylar neck area through a skin incision placed just behind the posterior border of the mandible. In this area the facial

nerve is approximately 2cm deep to the skin surface as it emerges from the stylomastoid foramen.

The skin incision is placed so as to utilize the "window" between either the superior and inferior divisions of the facial nerve or the buccal and marginal mandibular branches during blunt dissection to the ramus of the mandible. The retromandibular vein is also proximity in this area descending just posterior to the ramus of the mandible within the parotid gland.

When compared with the other methods, the retromandibular approach offers greater advantages because of the shorter working distance from the skin incisions to the condyle, great access to the posterior border of the mandible and sigmoid notch , less conspicuous facial scar and easy reduction[59].

From the results of our clinical study conducted on 16 patients comparing the functional outcome of two different surgical modalities in the treatment of condylar fractures.

The restoration to pre traumatic occlusion was better in group II patients and the occlusal stability was ideal resulting in good functional rehabilitation compared with group I patients.

Long term follow up of both the groups of patients suggested that the pain associated with function was significantly less in group II patients and hence causing least discomfort.

The jaw dynamics also showed significantly better results in group II patients as inferred from the results of the study showing the improved protrusive movement and maximal inter incisal opening.

The study concluded that condylar fractures treated by open reduction and internal fixation resulted in a more rapid return to pretraumatic occlusion, improved functional outcome which resulted in early rehabilitation.

SUMMARY AND CONCLUSION

16 patients with unilateral condylar fractures were included in this study. 8 patients were treated conservatively and 8 patients underwent open reduction and semi rigid internal fixation. The follow up period ranged from 0 - 18 months.

The present study concluded that :

i) On clinical observation the incidences of mandibular deviation towards the fractured side was more common in patients treated conservatively. In contrast it occurred less often in patients treated with open reduction and internal fixation.

ii) Mouth opening was significantly better in patients treated by open reduction.

iii) Pain in the temporomandibular joint was moderately high in patients treated by closed reduction.

iv) No statistically significant differences were found for lateral excursive movements.

v) Facial nerve weakness were transient and temporary in 2 patients which returned to normal function in the periods of follow-up.

We hereby concluded that closed treatment is preferable for treating fractures of the condyle which are undisplaced, whereas all other fractures with mild to moderate deviation /dislocation we advise to treat it surgically.

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